E17392

N/12
202
M. No 19

Manufacture of Steel

IN

H. E. H. the Nizam's Dominions

READ

BY

NAWAB SALAR JUNG BAHADUR

NAWAB AHSAN YAR JUNG BAHADUR
C. E. (Cooper's Hill), M. I. E. (India)
Retired Chief Engineer & Secretary, P. W. D.
H. E. H. the Nizam's Government,
HYDERABAD-Deccan.

AT

THE HYDERABAD CENTRE

OF

The Institution of Engineers (India)

ON

19th AUGUST 1940.

672.809549
MAN

Salar Jung Library
WESTERN
SECTION.

P/13-A.N
202-S.N

CHECKED 67
1384,
1986

Manufacture of Steel

IN

H. E. H. The Nizam's Dominions.

---

1. **History.**—Considering the chronological epoch in world history, man's development can be divided into four main stages. 1. Stone Age, 2. Bronze Age, 3. Iron Age, 4. Alloy Steel Age. In the first or Stone age, metal was unknown and all implements were made of wood, stone and bone. In the second or Bronze age, metals were discovered and Copper and Tin were alloyed together to produce Bronze. The third or Iron age was reached, when mankind succeeded in preparing Iron economically so that it could be used for all purposes, as Bronze was much more expensive. The present age is the fourth Age, when iron and ordinary steel are being replaced by Alloy steel. The development of the Iron age is highly interesting. It is generally agreed, that Iron industry is truly oriental and was taken into Europe by the Celts from the East. Biblical and Quranic references are that David handled iron, like any soft article, making highly elaborate Arms and Armours at Lebanon and he also used a good deal of iron in Solomon's temple. The Assyrians and Egyptians have made considerable use of this metal. It has been stated that the earlier sources of the ore have been discovered

in India and the use of Iron has been observed by Archaeologists since 4000 B. C.

2. **Primitive Process.**—The primitive method which survives even to-day at Dasturabad, on the banks of the Godavari, is that rich ore is ground and smelted in a furnace mixed with charcoal, the fuel is added from time to time and a good blast of air is maintained. The ore becomes a spongy mass, which is removed and immediately hammered while still white hot. This expels all the slag and the particles of iron are welded together to form one coherent mass.

All the ancients made their steel by the following process; making pure wrought iron first, similar to the method described above, then adding the requisite amount of carbon which is absorbed in heating the wrought iron again, and hammering it into steel ingots.

3. **Present Practice.**—As civilisation advanced and the use of iron increased, the old process was improved to meet the increased demand. Large and high furnaces were introduced and liquid iron, a complex alloy, was produced with a good deal of carbon, but it was easily fusible. This iron was called Pig Iron, owing to the impurities it contained and had to be converted into steel, either by the Bessemer or the Open-hearth process. Modern metallurgical developments have consequently replaced the simple ancient direct production of wrought iron by the highly complex indirect process of manufacturing steel. As we all know, this causes the pig iron to alloy

with undesirable impurities which cannot be eliminated later and renders the modern mild steel very much inferior to the old steel produced by the direct process *i. e.* without making Pig iron first, and thereby imparting the impurities which did not exist in the ore and then removing them for the conversion into steel.

4. **Electric smelting and Alloy steel age.**—Since 1910 many experiments on a large scale have been carried out, specially in Electric furnaces for producing high class steel by direct process.

Electric furnaces have been extremely successful of late and the advantages of electric heat are :—

(a) Ability to generate a high temperature and thus to cause certain desirable reactions to occur.

(b) Virtual absence of products of combustion and their undesirable compounds of Carbon, Hydrogen, Sulphur and Oxygen.

(c) Ability to remove slag and make up new ones, thus controlling refining reactions.

(d) Metal is hotter than the refractory, a prime advantage in cost over crucible melting.

(e) Less slagging of alloying elements, thus making for economy and control of

NAWAB SALAR JUNG BAHADUR

chemical composition within narrow limits.

Our requirements at the present age need a high grade steel, not only for the manufacture of Armaments, but also for Heavy machinery, Railway appliances, Aeroplanes, Motor cars, Lorries and Machine tools.

It has been established that the addition of alloys, specially, Chromium, Manganese, Aluminium and Silicon to steel, increases its strength and hardness considerably, without a corresponding increase in brittleness. There is no doubt that there are infinite possibilities in alloying and it can be safely prophesied that alloy steel will very soon replace the ordinary steel, as the cost of production of Ferro-Alloys is reduced. Reduction in cost of manufacture can be easily attained by the use of Electric Furnaces. Moreover, statistics show that Electric Steel has already supplanted crucible steel in America, but has not been so successful in Great Britain. Italy being rich in water power, but poor in fuel, has more than 200 electric furnaces with an annual capacity of one million tons. In fact, all experts agree that an electric furnace is more suitable for refining, alloying and melting cold steel scrap than any of the Bessemer and Open-hearth process.

5. **Direct Process.**—There can be no doubt that the future is for Alloy Steel and we are now well within the Alloy Steel Age. All new undertakings have to consider, very carefully, the question of establishing the

manufacture of steel by the direct process, which I am quite certain, is going to supplant the present indirect system of smelting ore to an impure product first and refining the same afterwards for conversion into steel.

Moreover, it is agreed by all experts that magnetic iron ores are more amenable to treatment in electric furnaces, and by the direct process alloy steel can be produced cheaper than the indirect process practised at present. Mr. K. K. Sen Gupta, the well known Metallurgist of Behar entirely agrees with my views. His opinion as published by the Associated Press is given below :—

"Large deposits of magnetic iron ore are reported to have been discovered by Mr. K. K. Sen Gupta at Gore and other places near Daltonganj, Bihar. The find is of considerable importance on account of the demand of iron and steel at the present moment. Electric smelting of these ores directly to steel, according to Mr. Sen Gupta, is a feasible proposition; avoiding thereby the cumbersome intermediate process of conversion into pig iron in the ordinary blast furnace before finally turning into steel. It will thus be much cheaper, as magnetite ores are more amenable to electric treatment and consume less current than Hematite which is mostly used in the existing iron and steel works in India."

6. **Comparison of Magnetite ore in Godavari Valley and in Sweden.**—Magnetic iron ore exists in the Godavari valley on both banks of the river, from the present road bridge at Soan, right up to Bhadra-

chalam and was discovered by me when I was Development Commissioner for this extensive area in 1920. Slag from ancient smeltings and also masonry furnaces are found all along the river. At Dasturabad, on the North bank, steel making by the ancient processs is still carried on as a cottage industry. In fact, this steel is of such high quality that the well known Damascus and Persian blades were manufactured and sold at Nirmal. Jagtial, Nirmal, Yalgadab and Warangal are noted for their cast steel ingots which were also exported to distant places. The ore is principally magnetite, occuring in hard quartz schist, penetrating the older gneiss, characteristic of the Dharwar system. Rich iron ores exist in the adjoining province of Central India and also in the neighbouring Bastar State.

A table of Assays of magnetic iron ore of the Godavari valley and of the well known Swedish ore in the hills of Kiruna is given below :—

Kind of ore.	Fe. %	P. %	S. %	Sio$_2$. %	Mn. %	Other minerals. %	Remarks.
Kiruna Sweden Magnetite. (Average)	62.5	3.5	0.05	6.55	nil.	Titaniferous minerals. 0.50	
Hills North of Godavari, Chityal, Kalleda, Dasturabad, etc. (Average of all hills.)	39.28	0.18	nil.	43.00	nil.	nil.	
Hills south of Godavari, Ambaripet area (Average of all hills.)	46.88	0.18	nil.	35.40	nil.	nil.	
Before magnetic concentration. (As above)	46.88	0.18	nil.	35.40	nil.	nil.	
After magnetic concentration. (by ordinary magnet.)	70.32	0.30	nil.	5.12	nil.	nil.	

There is no doubt that our magnetic ore is inferior to the Swedish ore, as it contains a large quantity of Silica and will have to be prepared before smelting. American and Swedish magnetic ores of low grade, similar to our Godavari valley ore, are concentrated, by fine grinding and drawing the iron bearing minerals out of waste rock with strong electro magnets.

This fine magnetite is sintered by moistening, mixing with coal dust and spreading over a travelling grate, the coal being ignited and burnt. The resulting clinker smelts so much more easily than the dense magnetic ores, that the ore even of high grade, are frequently sintered in the American Plants.

Results of magnetic concentration of our ore by ordinary magnet is given above. The percentage of iron in the concentrated ore increases from 46.88 to 70.32% and the quantity of Sio_2 decreases considerably from 35.40 to 5.12%. It is certain that if proper machines of the Monarch and Wetherill types are used, the strong electro magnets will pick up practically all the iron out of the waste rock which in our case is mostly silica.

Referring to the Swedish mines of Kiruna, it has been observed that the surface samples are always leaner than the deeper ones. The ore deposit is geologically very similar to our Godavari ore. The Swedish ore is also enclosed inside walls of very hard fine grained Porphyry, similar to the side walls of quartzite and gneiss, in the case of Godavari ore.

The lengths of the Kiruna and Luossavaara Swedish ore deposits are about 3 miles and 1 mile respectively, the widths vary from 328 to 164 feet and the depths from 1500 to 3000 feet. The dip of the Swedish ore body is 55 to 60 degrees while the dip of our ores is practically vertical in the hills of the Chityal group and nearly 45 to 60 degrees in the hills of the Ambaripet group. The depths of ore in

the hills of the Godavari valley, as approximately ascertained, vary from 200 to 1000 feet and the widths from 50 to 160 feet.

The Godavari valley deposit is not in one continuous hill like the Kiruna in Sweden but the outcrop is in isolated hills, all along the river on both the banks. If the length of the richer outcrops in all the hills is added together, it may extend to more than 5 miles; leaner ore, however, is to be found in nearly all the hills on both banks of the river for a distance of more than 200 miles.

7. **Mining in Sweden.**—It has been found in the Kiruna mines that the ore can be recovered by open cut operation and also by underground mining but most of the ore is recovered by open cut workings. The porphyry rock from one side is stripped back for some distance, by blasting it with vertical and horizontal holes, so that a clear working face is obtained for removing the ore which is blasted in the same manner. The overburden of fine closed grained porphyry is very hard, making the drilling operation difficult. Drilling and loading operations are all performed by electrically driven drills and electric shovels; the quarry railway is also worked by electric power.

In the above mentioned Swedish mines the expenditure on spare parts and repairs to the shovels is kept very low, in spite of the extremely heavy work and the abrasive nature of the material. As the deposits of high grade ore increase with increasing depths and the demand for it is great, it has been found profitable to carry on underground mining operations for the high grade ore only. The ore is crushed at the mines, so as to remove the mineral Apatite which occurs in the ore, in some cases as minute grains desseminated through the magnetite, in others as fine veins and stratified masses. As a rule only the high grade ore is exported and the lower grade ore is utilised locally in the country after magnetic concentration. Dr. Heron states in his report that mining of the Godavari ore will be most difficult. It will be observed from the above description of mining Swedish ore that it will not be more difficult.

8. **Quality & Quantity of Godavari Ore.**—From the above description it will be observed that there is a great similarity between the Swedish ore and Godavari ore and it is expected that when deep borings are taken in the Godavari areas the iron content will increase as it does in the Swedish mines. I am sure the average proportion of iron in the Godavari ore will come up to 50% which when concentrated will result in a very rich ore; the proportion of iron becoming nearly 75%. The Silica content also gets reduced considerably as is seen from the results ; hence it may not be necessary to use sintering if the electrical process is adopted.

The quantity of ore, varying in contents of iron from 40% to 47%, at present approximately ascertained from the height of surface outcrops, is nearly 300 million tons. It is certain that when deep borings are taken the quantity available will be more than 600 million tons as the depths of the deposits are much more than what are roughly estimated at present. As stated before, the ore exists all along the river Godavari on both banks for nearly 200 miles. There is no doubt that this ore appears to be lean, in surface samples, varying from 20 to 30% iron, but the quantity is considerable and it is also expected that richer ore exists down below. The quantity of the leaner ore, approximately estimated, will be more than 1000 million tons. Both in England and Germany the local ore available is very poor, averaging from 27½% to 37½% and it is for this reason that large quantities of rich ore are imported from Sweden. In America also, the average content of iron in the ores has dropped from 55½% to 51¾%, as the richer ores are getting exhausted.

With regard to the position in our Dominions, it may be mentioned that there are very large quantities of fairly rich iron ores available in the neighbouring Central Provinces and Bastar State and can be imported if required, after the ore in the Godavari valley is exhausted. Any prediction about the age of a mining area must also prophesy as to the state of the future art of ore concentration; the lean ore to-day may become a workable ore to-morrow. Hence the question of the likelihood of the available iron ore being exhausted has to be considered in the light of facts mentioned above.

The principal areas in the Godavari valley containing the workable rich ores are:—

1. South of the Godavari in **Kareemnagar** District (Ambaripet area).

	Quantity in million tons.	Percentage of iron
Chandoli Hills.	80.06	41.24
Kondapur ,,	56.11	45.26
Sherkonda ,,	15.23	48.31
Other hills within a range of 10 miles of Chandoli.	3.86	52.74
2. North of Godavari in Adilabad District.		
Chityal group.	20.77	36.50
Dharmajipet, Kalleda, Birsaipet groups.	126.70	40.26
Total million tons.	302.73	

9. **Present Demand and Future Prospects.**—The imports of iron and steel and machinery etc., within the Dominions in 1346 Fasli were as follows:—

	Maunds	Value in O. S. Rs.
1. Iron and steel.	4,98,254	45,25,784
2. Machinery and Mill work including prime movers). (a) Agricultural machinery (b) Sewing machines (c) Knitting machines (d) Typewriters (e) Other machines and parts	1,05,240	31,57,122
3. Railway plant and rolling stock.	1,23,300	37,07,000
Total..	7,26,794	113,89,906

or about 26,000 tons.

On account of more building operations and increase in trade, the present demand I expect now is about 30,000 tons annually, including machinery and plant; but with the industrial development before us, the demand for the next decade is likely to be 50,000 tons annually.

Some of the future prospects as to consumption of steel are mentioned below:—

1. Development of large key Industries, Manufacture of Heavy machinery, Armaments, Aeroplanes etc., in the Dominions.

2. Automobile factory in Bombay.
3. Ship building factory at Vizagapatam.

As regards the Automobile manufacture in Bombay, a great deal of high grade steel will be required. The Hyderabad Steel Works will be nearer to Bombay than any other steel works in India. No doubt, at first, the factory will utilise imported parts but in a few years it is certain, that subsidiary enterprises in India will be established rapidly and within 5 years all steel parts and accessories needed for the production of modern cars, lorries and armoured cars will have to be made available in large quantities, to enable competition with foreign mass producing factories. With reference to the future ship building yard at Vizagapatam, there is no doubt that Tata Steel may be utilised but as the distance from the Hyderabad Steel works will be less, the high class steel can be drawn from the Dominions.

Hence the proposed steel works have to be at least of 50,000 tons annual output at first. It can be duplicated as soon as the demand for steel increases in the Dominions and the neighbouring Provinces. With these prospects it will be seen that for an output of say 100,000 tons of steel annually, the ore required will be 300,000 tons and at this rate, the rich ore mines can be worked for 2000 years. If the annual output of steel is increased to 1 million tons, the rich ore can last for 200 years.

The annual production at Tatanagar for 1940 is likely to be 750,000 tons of steel and 1 million tons

202
A/13

of Pig iron. They are contemplating to manufacture steel by a new process which it is anticipated will prove highly economical in application to Indian materials.

The annual output of the Mysore Iron Works is approximately 25,000 tons but the works are to be expanded very soon to an output of 50,000 tons annually.

10. **Method of Manufacture Recommended.**—As mentioned above, the Godavari ore being magnetite is more amenable to treatment in electric furnaces. Even Dr. Heron who has expressed highly pessimistic and disappointing views about the Godavari ore, agrees that it can best be treated in the electric furnace like Sweden. There is no doubt that our coal cannot be converted easily into hard metallurgical coke suitable for blast furnace. Hence the idea of smelting the ore by the usual indirect process in blast furnaces has to be given up. Smelting by charcoal is not advisable, as the cost of charcoal is fairly high and it is not to be had in such large quantities as would be required for an annual output of 100,000 tons of steel. Mysore Iron Works are having difficulty in obtaining the charcoal supply required for their present annual production of 25,000 tons and are contemplating the adoption of electric furnaces as soon as cheap Hydro-Electric Power is available from the Jog falls.

Indian Steel Rolling Mill Ltd., Madras, is establishing a factory at Negapatam for melting steel scrap and rolling sections; also manufacturing alloy steel by the electric process, utilising the electric energy

NAWAB SALAR JUNG BAHADUR.

available from the Papanasam scheme in Southern India (Madras Presidency).

The advantages of electric steel and the economies that can be affected in adopting the direct process have already been mentioned above.

As the coal available from the nearby Tandur mines is not cakeable, it is proposed, at the commencement, to instal a Thermal Electric Plant of 32,000 K. W. with economical up to date boilers of Velox type using pulverised fuel and highly efficient steam turbines.

With coal dust delivered at the works at Rs. 3/-per ton the cost of generation will, I am certain, be not more than 2 pies per K. W. H. as the load factor will be the highest obtainable.

When Hydro-Electric Power is supplied from the Godavari scheme, the cost of electric energy can be further reduced to nearly half; namely one pie per K. W. H. Here also, the same arguments apply; with high load factor more or less continuous, Hydro Power can be sold to the steel works at 1½ pies per K. W.H. with a fair return.

The steel works can be started at once, as soon as the prospecting is completed, which ought not to take more than 6 months, with two drills working continuously. Hydro Power cannot be made available right through the year, until the Kishtapuram Reservoir on the Godavari is constructed which may take at least 20 years. In the meantime even if the Hydro Electric Project is undertaken in stages, as recommended by me, the supply cannot be expected within five years from now and that too will be available only intermittently. In the first stage the generation will be 30,000 K. W. for 6 months and for 6 dry months only 6,000 to 3000 K. W. In the second stage, however, say after another 5 years nearly 60,000 K. W. can be generated for 6 months and 6,000 to 12,000 K. W. for the 6 dry months. In the third stage when the Kishtapuram Reservoir on the Godavari is completed, say after 20 or 25 years 60,000 K. W. can be generated continuously. It is for these reasons, I have recommended a Thermal Plant generating 32,000 K. W. so that it may be used as a standby and substitute when Hydro-Power is made available.

Moreover, the first stage of the Hydro-Electric scheme will cost at least one crore of rupees, which is difficult to finance just now together with 1½ crores required for the steel works.

11. **Site of Steel Works.**—As the richer ore is on the southern bank of the Godavari, in Kareemnagar District and the mines are only 20 miles from the Kazipet-Balharsha Railway, it is proposed to establish the steel works at Antargaon, a village between R. S. Ramagundam and the river bridge, on the south bank adjoining the Kazipet-Balharsha Railway. For transporting the ore from the mines to the Steel Works a light railway can be constructed quite easily at Rs. 25,000 per mile costing in all 5 lakhs. Later on after a century or so when it is

necessary to convey the ore from the Chityal groups of hills the same railway can be extended.

It is necessary to mention here that the site is more or less central, both as regards the supply of steel in the Dominions and outside to Bombay (via Secunderabad and Wadi), Vizagapatam and Madras (via Bezwada) and Nagpur (via Balharsha).

The distance by rail from the Tandur coal mines, adjoining Bellampalli Railway Station on the Kazipet-Balharshah Railway to the site of the steel works is only 20 miles and dust coal will not cost more than Rs.3/- per ton delivered at the works.

12. Cost of Plant and Manufacture.

4—8000 K. W. Thermal plants, including erection etc. complete. ..	B.G. Rs.	48,00,000
4—Electric Furnaces of 50 tons capacity, complete. ..	,,	18,00,000
2—Other furnaces complete.	,,	5,00,000
1—Rolling mill complete 150 tons daily capacity. ..	,,	18,00,000
Buildings etc. ..	,,	9,00,000
Cost of light Railway 20 miles	,,	5,00,000
Cost of land, water supply etc.	,,	5,00,000
Prospecting expenses etc.	,,	2,00,000
Working capital and other expenses. ..	,,	40,00,000
Total	B.G. Rs.	150,00,000

Cost of manufacture of 1 ton of Steel by the direct process.

Blasting, Grinding and magnetic concentration of 3 tons of ore, including carriage to site	B. G. Rs.	20-0—0
Electrodes etc. ..	,,	6—0—0
Furnace renewals and labour etc. ..	,,	8—0—0
Charcoal, fluxes, alloys etc.	,,	12-0—0
Maintenance of staff for Power House Furnaces etc. (including cost of electric energy).	,,	20-0—0
Rolling into sections ..	,,	10-0—0
Depreciation. ..	,,	14-0—0
Total cost of Rolled Steel	B. G. Rs.	90-0—0

The new direct method of manufacturing steel by electricity is anticipated to prove highly economical, specially in application to the Godavari iron ore. I am certain, nowhere in India steel ingots can be manufactured at B. G. Rs. 80/- per ton and rolled steel at Rs. 90/- per ton.

13. **Financial Position.**—A few months ago many European experts regarded as impracticable any big schemes to build heavy machinery, ships, aircrafts, armoured lorries and motor cars in India. To-day circumstances have changed so rapidly that though great many technical objections they had in mind still persist but they can be overcome. It is also a good augury that both Indian industrialists and Government have exhibited an earnest desire and will to

tackle these imaginary obstacles. The old saying "Where there is a will there is a way" is true and success is certain, owing to the present and future demand for the large basic industries that are to be developed in India.

It is a great satisfaction that notwithstanding the drain on the general wealth, the capital required for the three large ventures put up by Mr. Walchand Hirachand, viz. 1. Ship building at Vizagapatam, 2. Motor Car Factory at Bombay and 3. Aeroplane Factory at Bangalore has been subscribed in India and no foreign aid was found to be necessary. Indian capital is no more shy now, as it was stated to be by foreign exploiters, and India is no longer a helpless uneducated and a semi-civilised nation of mere "Hewers of wood and drawers of water." India has proved during the war that it has the will and the skill for rapidly establishing and developing the basic industries, so that it can become a self-supporting Industrial Nation, able to produce without foreign aid, all the essentials necessary for a mechanical age.

At the present time, industrialisation is absolutely necessary for our progress, and economic freedom is the foundation in the building up of a prosperous and free nation. Self-sufficiency only can lead to freedom and as such the key industries should be established and made to flourish first.

In the present mechanical age, steel manufacture is of paramount importance and the need to develop it is absolutely necessary in these times of war.

A nation strong in steels is strong in arms and strength in arms is the only means of success.

Tata, the world famous industrial magnate was a great politician as well. He foresaw the essential needs of the Indian nation, struggling to attain economic freedom and not withstanding the great disappointments and discouragements, stuck to his guns. The capital invested in Tata Iron and Steel Company amounts to 10½ crores and the annual production for 1938–1939 was as follows:—

Coke	..	8,65,000 tons
Pig Iron	..	10,20,000 ,,
Steel ingots	..	9,44,000 ,,
Saleable steel	..	7,01,000 ,,

It is expected that the annual production of steel for 1939–40 will be at least 7,50,000 tons.

The Mysore Iron Works with a capital of 1½ crores (excluding wood distillation plant) are producing more than 20,000 tons of steel annually.

I have mentioned only 2 companies, as they are likely to be our competitors and will try to reduce their rates considerably; but this is not likely to last long as the demand will be great and we shall be manufacturing high class alloy steel. The prices for rolled mild steel have steadily increased since 1935. In 1935 and 1939 the prices per ton were as follows:—

	1935	1939 (Before the war)	1939 After the war).
Angles, Tees and joists average.	125	145	176
Plates. ..	130	158	188

If the war does not come to an end early, the trend of prices for steel will be still high. In 1939 the average gross profit per ton of rolled steel at Tatas was Rs. 70. In our scheme also if we manufacture only mild steel the gross profit will also be Rs. 70/-per ton but if alloy steel is turned out the profit will be Rs. 100/-per ton. The gross profits estimated for 1939-40 of the Tata Iron and Steel Company is going to be about 530 lakhs (after allowing office expenses, interest charges and Agent's commissison of 45 lakhs) which is on subscribed capital nearly 40% and the net return, after providing 85 lakhs for taxes etc., 95 lakhs for depreciation, 50 lakhs for reserve fund, 52.5 lakhs for bonus to labour and 9 lakhs C. F. and addition of 28 lakhs from last year balances, the net balance available for distribution will be 266.5 lakhs, resulting in a net return of over 20%. Hence it can be safely stated that in our proposed scheme a net return of 20 to 25% can be expected.

14. **How is Capital to be Obtained.**—In the case of Mysore Iron Works the whole of the capital is provided by Government and the concern is managed as a Government department no foreign capital having been called for or encouraged. In the case of Tata the whole capital has been subscribed in India and the business is considered as a National undertaking.

The three new concerns, Ship building yard, Motor car and Aeroplane factories, inaugurated by Mr. Walchand Hirachand will probably require a capital of 5 to 6 crores which is going to be fully subscribed in India without any foreign aid. In our Dominions, it may not be possible to raise a capital of 1½ crores at this time, but Government can, like Mysore, provide the capital as a completely owned concern and manage the same as other capital works, which I am afraid are not so remunerative as this concern is sure to be.

15. **When Manufacture is To Be Started?**—Preliminary investigations have already been carried out. It is necessary now to set about in a businesslike manner and carry out detailed prospecting in the Ambaripet area, south of the Godavari, by a special Metallurgist and Geologist. The investigation in this area will cost approximately 1½ lakhs, as per details below and the work in this area can be finished in 6 months after the operations are commenced.

Two Ingersoll Rand "MD-3" Coroc Diamond drills equipped with petrol kerosene engine complete with tools etc. for 300 ft. depth. (As per latest quotation vide their letter dated 4th July 1940 F. O. R. Bombay). ..	B.G. Rs. 70,000/-
Carriage to site etc.	,, 3,000/-
Cost of drilling including spare parts etc.	,, 30,000/-
Metallurgist for six months ..	,, 10,000/-
Engineer and Office establishment for 6 months and touring charges ..	,, 10,000/-
Contingencies etc.	,, 5,000/-
Total B. G. Rupees.	1,28,000/-
Add exchange	22,000/-
Total O. S. Rs.	1,50,000/-

Messrs. Ingersoll Rand have agreed to supply the two drills from America in 14 weeks after placing the order. In the meantime a special Metallurgist and Geologist ought to be engaged so that he can inspect the sites and prepare the ground for detailed investigation.

Mr. K.K. Sen Gupta, M.A., B.Sc. (Calcutta), B.Sc. Mining, M.Sc. (Birmingham), F. G. M. S., Consulting Geologist and Metallurgist, Calcutta, who has had considerable practical experience of prospecting and mining in India can be engaged. He is the specialist who has discovered magnetic iron ore deposits in Behar and has recommended smelting this ore in Electric Furnaces; manufacturing steel by the latest direct process.

After the results of the investigations are found to be satisfactory, an American Specialist in electric smelting will have to be engaged for designing the steel works. It may be stated here, that even if the war continues, it will be possible to get all the equipment from America. Mr. Walchand Hirachand has engaged American Specialists for the establishment of the new industrtries. Tata has also appointed American Specialists for the new process of steel manufacture. America is the largest producer of Pig Iron and Steel in the world and it is therefore advisable to engage Americans for the present. Moreover, as large quantities of magnetite iron ore are being smelted in America, they are considered to be more experienced both in the indirect blast furnace and in the direct electric process. America is also the greatest manufacturer of electrical plants and can construct and equip very large power stations both Thermal and Hydro-Electric.

If all goes well and detailed investigations are taken up immediately by Government, the steel works can be established and steel produced within two years. Owing to the war, the demand for steel, specially alloy steel has increased enormously. Prior to 1910 its use was confined mostly to big guns, armour and projectiles; it has spread rapidly of recent years into all metal working industries, specially automobile, aeroplanes, machine tools and heavy machinery such as locomotives, etc. The world annual production of alloy steel has increased from 2 million tons in 1927 to more than 5 million tons to-day. Moreover, at present the question of competition with any Indian industry by foreign steel interests does not arise; on the contrary there will be an export demand from the neighbouring countries.

As the capital required is not very large and the returns are fairly high, our Government like Mysore ought to finance the whole undertaking. Impetus for all such key industries, necessary for industrial expansion as a whole, ought to emanate from Government.

8/13
SALAR JUNG LIBRARY

PRINTED AT THE OSMANIA PRINTING WORKS, SEC'BAD.